Study of the Feasibility of a Coal-to-Liquids Plant in Interior Alaska

Ms. Kelley Hand*, P.E., Mr. Joseph Carvitti*, Mr. Michael Rectanus*, Mr. Brian Boczek*, P.E., Mr. Bobby Diltz**

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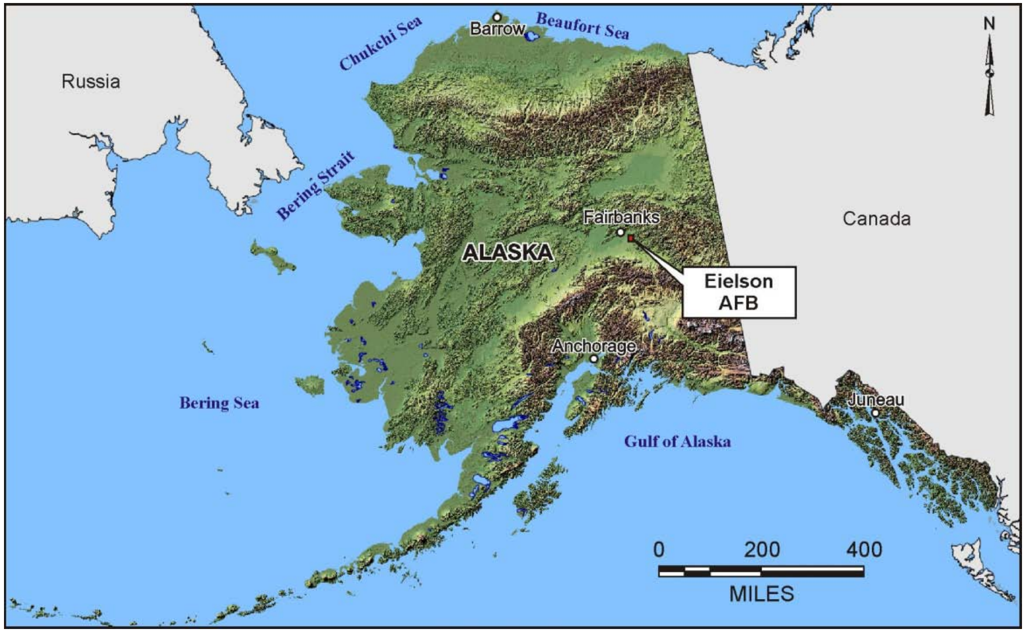
OVERVIEW

- Two-phase assessment of the technical feasibility of constructing a Coal-to-Liquids (CTL) plant on Eielson Air Force Base (AFB) near Fairbanks, Alaska.
- Based on a 2008 conceptual engineering design.

PHASE I	Evaluation of the feasibility of situating a CTL plant on Eielson AFB through an enhanced use lease (EUL) of base property, the engineering challenges associated with such a facility, and the mitigation of the adverse impacts on the base.
PHASE II (3 tasks)	**WATER** – Assess the options and strategies to mitigate impacts to ground water and surface water in the vicinity of the proposed CTL plant at Eielson AFB. **NOISE** – Assess noise and visual impacts on local environment. **AIR** – Conduct ambient $PM_{2.5}$ sampling near the proposed CTL site within Eielson AFB to better determine potential impacts from the plant on the nearby $PM_{2.5}$ nonattainment area.

PHASE I – CTL Conceptual Design

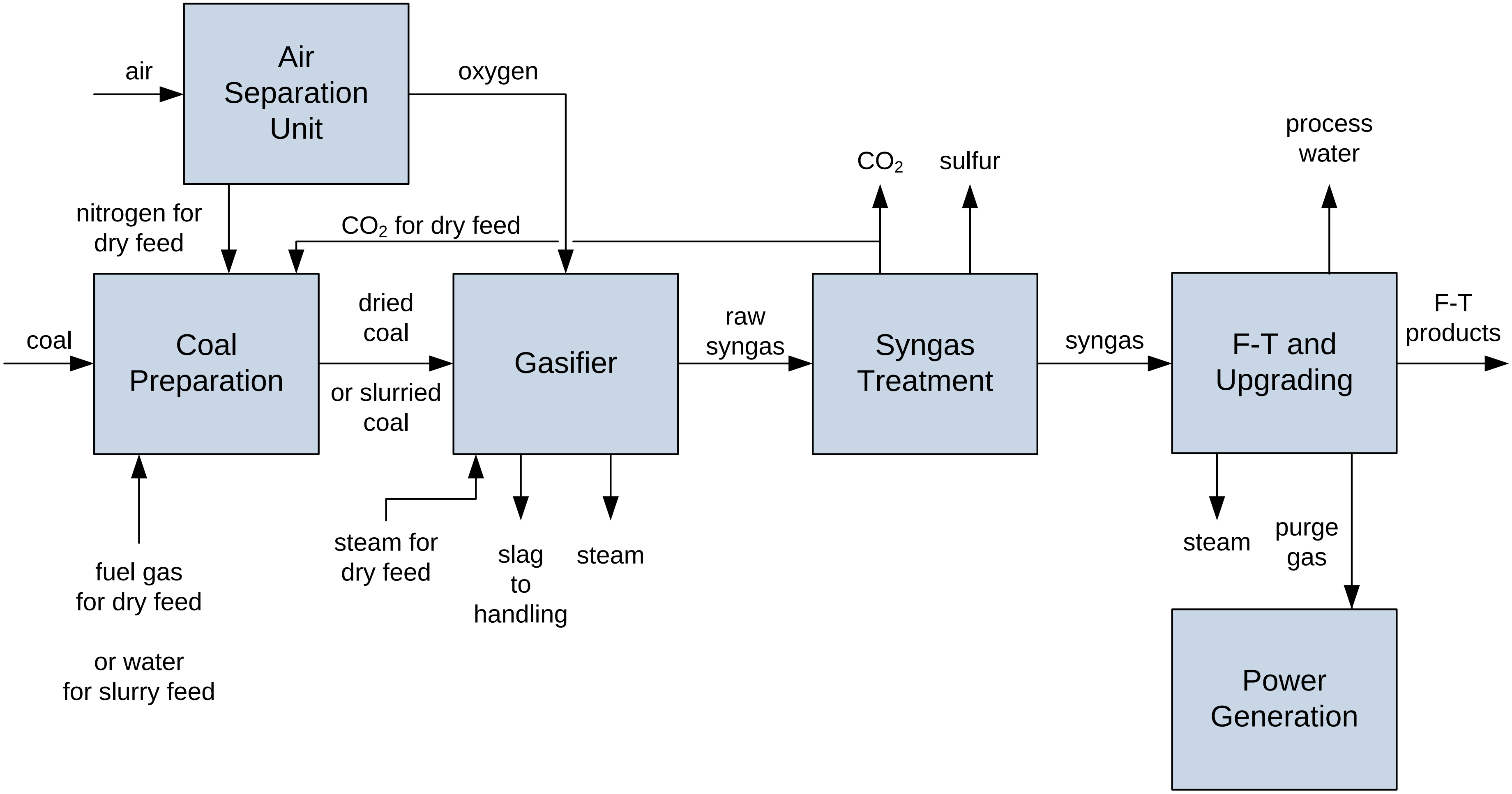
- Conceptual design prepared by Hatch Ltd. for a 40,000-bbl/day CTL plant.
- Plant areas reviewed included:
  - Coal Preparation and Air Separation Unit
  - Gasification and Slag Handling
  - Gas Purification and Syngas Treatment
  - Fischer-Tropsch (F-T) Synthesis & Upgrading
  - Power Generation
  - Water Treatment



PHASE I – CTL Conceptual Design (cont.)

- Based on selection of proven technologies at the required scale, as well as:
  - Jet fuel, diesel, and naphtha products
  - Use of a dry feed, slagging, entrained flow gasifier
  - Electrically self-sufficient, including 60 to 200 MW of electricity to export
  - Export waste heat for district heating
  - Use of technologies that recover as much waste heat as possible in the form of saturated steam
  - Minimum 92 percent plant availability
  - Minimum 30-year life cycle~~.~~

PHASE I – Basic CTL Fuels Production Process



PHASE I – Issues Considered in Battelle Feasibility Study

- **Location and Land Use**
- **Plant Construction and Operation**
- **Ability to Use Products and By-Products**
- **Carbon Dioxide Disposal**
- **Transportation and Logistics Feasibility Issues**
- **Environmental Considerations**
- **Economic Feasibility**
- **CTL Plant Risk Assessment Issues**
- **CTL Plant Impact on Eielson AFB Mission**

PHASE I - Conclusions

- Determined to be technically feasible.
  - Adequate coal supplies.
  - Local fuel markets are large enough to absorb all the diesel and jet fuel produced by the plant.
  - Economic feasibility will depend heavily on the actual local demand for liquid fuels, local fuel prices, and on the commitment of the Air Force to buy F-T jet fuels.
  - Additional study of local markets for naphtha, excess electricity, and excess steam is needed.
  - Further study is needed to find markets for or dispose of crushed slag, coal ash, sulfur, and other by-products.

PHASE I – Conclusions (cont.)

- Major environmental issues include $PM_{2.5}$ emissions, possible ice fog formation, and effects on local hydrology, particularly groundwater.
- CO_2 capture is possible; sequestration depends on the ability to use the CO_2 for enhanced oil recovery and/or the availability of a disposal site.
- Due to size and location, potential exists to cause significant transportation impacts to road, rail, and ports.
- Potential air permitting issues depending on the terms of the lease and the degree of integration of the CTL plant with Eielson AFB operations.
- Water emissions could cause an increase in the formation of ice fogs.
- Overall, no mission incompatibility issues.

PHASE II – Water Resources Assessment

- Primary research objectives included:
  - Characterize available aquifers and surface water sources.
    - Determine workable levels and sustainability
    - Assess ability of surface water to augment potentially available aquifers
  - Assess environmental impact of withdrawing water from aquifer or surface sources.
  - Investigate the feasibility to recycle water or utilize low quality water to support production.
  - Include other discharge options, such as potential closed system designs and discharging water back into aquifers or surface water sources.

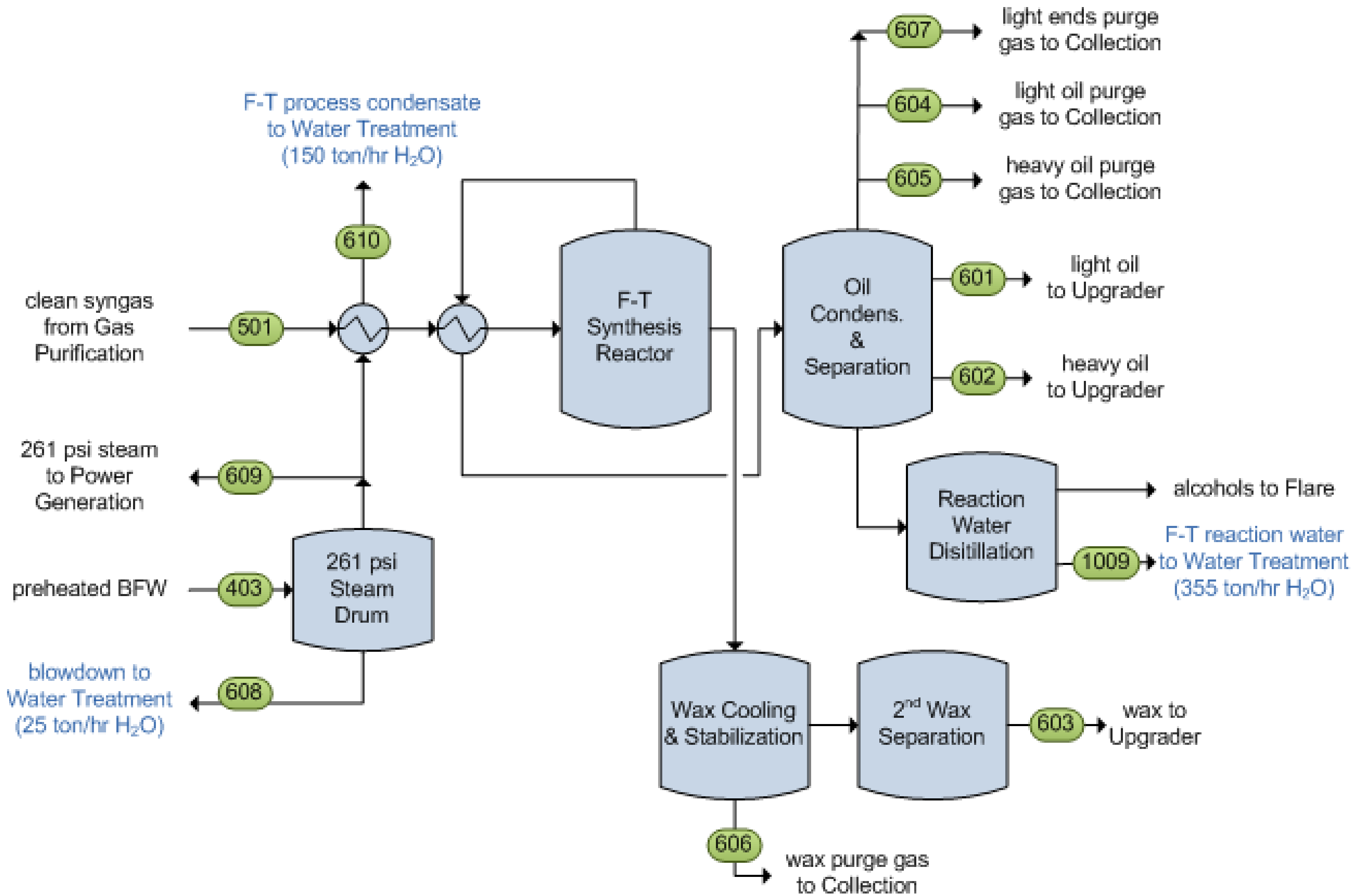
PHASE II – Water Resources Assessment

- The main water requirements of the CTL plant are:
  - **Chemical reaction water -** this water is not discharged; it becomes part of the fuel.
  - **Process and boiler feed water (BFW) -** water used to produce steam and for other processes. Boiler blowdown may need to be treated prior to discharge.
  - **Contact cooling water -** water for slag and ash cooling or injected into the gasifier to control reactor temperature.
  - **Non-contact cooling water –** recirculated water used only for cooling.
  - **Evaporative cooling water -** water used by wet cooling towers. This water is lost to the air through evaporation in the cooling tower.

PHASE II – Water Resources Assessment

- Evaluated water uses and discharges for each process area, including:
  - Gasifier train
  - Gas treatment area
  - F-T process unit
  - Utilities (including water and wastewater units)
- Although conceptual design only considered a dry feed system, this assessment considered the water impacts of both dry and slurry feed systems.
- Researched and acquired data to fill gaps in conceptual design report.

PHASE II – Water Resources Assessment – Water Balance Example



PHASE II – Water Balance Example – Fischer-Tropsch Synthesis

- Mass of F-T reaction water was not specified.
  - In general, all hydrogen in the syngas is used to produce either hydrocarbons or water.
  - Used reaction stoichiometry and available data to estimate.
    - $CO + (1 + m/2n)H_2 \rightarrow (1/n)C_nH_m + H_2O$

Stream No.	Description	Phys. State	Flow Rate (ton/hr)	wt% H_2O	Water Flow Rate (ton/hr)	In/Out Stream	Source/Calculation
403	Preheated BFW to 261 psi Steam Drum	liquid	1,274.2	100.0	1,274.2	in	Hatch
601	Light oil to Upgrade	liquid	86.4	1.8	1.6	internal	Hatch
602	Heavy oil to Upgrade	liquid	48.4	0.4	0.2	internal	Hatch
603	Wax to Upgrade	liquid	85.7	0.7	0.6	internal	Hatch
604	Light oil purge gas to Collection	gas	6.8	1.1	0.1	out	Hatch
605	Heavy oil purge gas to Collection	gas	0.6	1.7	0.0	out	Hatch
606	Wax purge gas to Collection	gas	0.9	19.8	0.2	out	Hatch
607	Light ends purge gas to Collection	gas	117.5	0.2	0.3	out	Hatch
608	Steam Drum blowdown	liquid	25.5	100.0	25.5	out	Hatch
609	281 psi steam to Power Generation	gas	1,098.6	100.0	1,098.6	out	Hatch
610	F-T condensate to Demineralization	liquid	150.1	100.0	150.1	out	Hatch
1009	Reaction water from F-T Water Distillation	liquid	359.0	98.8	354.8	out	Stoichiometry and Sasol Patent US 7,153,432.

PHASE II – Water Resources Assessment

- Water balance around CTL plant used to estimate range of water usage (depending on use of treated process water).
  - Range estimated for both dry and slurry feed gasifiers.

Entrained Flow Gasifier Feed Option	Initial Charge (1,000 gal)	Maximum Water Usage Rate (i.e., 100% discharge) (1,000 gal/hr)	Water Sent to Treatment (1,000 gal/hr)	Minimum Water Usage Rate (i.e., 100% reuse) (1,000 gal/hr)
Dry	1,700	350	370	0
Slurry	2,000	550	280	270

- Technologies are available to treat wastewater so that it can be reused in the CTL plant.
  - Reverse osmosis may be used for treatment of the BFW.
    - RO → large demand for electricity to power the high-pressure pumps, however, excess electricity expected from CTL plant.

PHASE II – Water Resources Assessment

- The maximum water usage rate for the proposed CTL plant is unlikely to negatively impact **ground water** resources and availability at a regional level.
  - Estimated to decrease available water resources in the Eielson subbasin by only 0.4%.
- Select **surface water** resources could possibly be used to supplement raw ground water make-up for use by the proposed CTL plant, but are limited by:
  - the seasonal availability of water above existing water rights and instream flow reservations; and
  - the presence of anadromous fish species in the surface water bodies.

PHASE II – Sound and Noise Assessment

- Current Sound Environment
  - Overall, the Eielson AFB environment is very quiet.
  - DoD operations cause brief daytime excursions.
- Noise from Proposed CTL Plant
  - Sounds levels below daytime but above minimum nighttime background and would therefore be audible.
  - Additional noise from increased rail traffic in vicinity of base housing – 12 trains per day versus two currently.
- Possible Mitigation Measures
  - Enclose CTL plant.
  - No strategies for mitigating rail noise.

PHASE II – Visual Assessment

- Current Conditions
  - Proposed CTL site is currently an undeveloped area.
  - Well-kept location that has formal architectural standards.
  - Considerable visual impact on immediate vicinity.
- Impact of CTL Plant
  - Least visual impact if constructed on the side of Engineer Hill away from the main base and below the crest.
- Mitigation Measures
  - Design enclosures that match existing architectural standards.
  - Screening the plant with trees.

PHASE II - Computer-Generated CTL Plant Simulation

- **Plant sited on side of Engineer Hill with simulated trees to screen plant viewed from Transmitter Road, west of plant.**

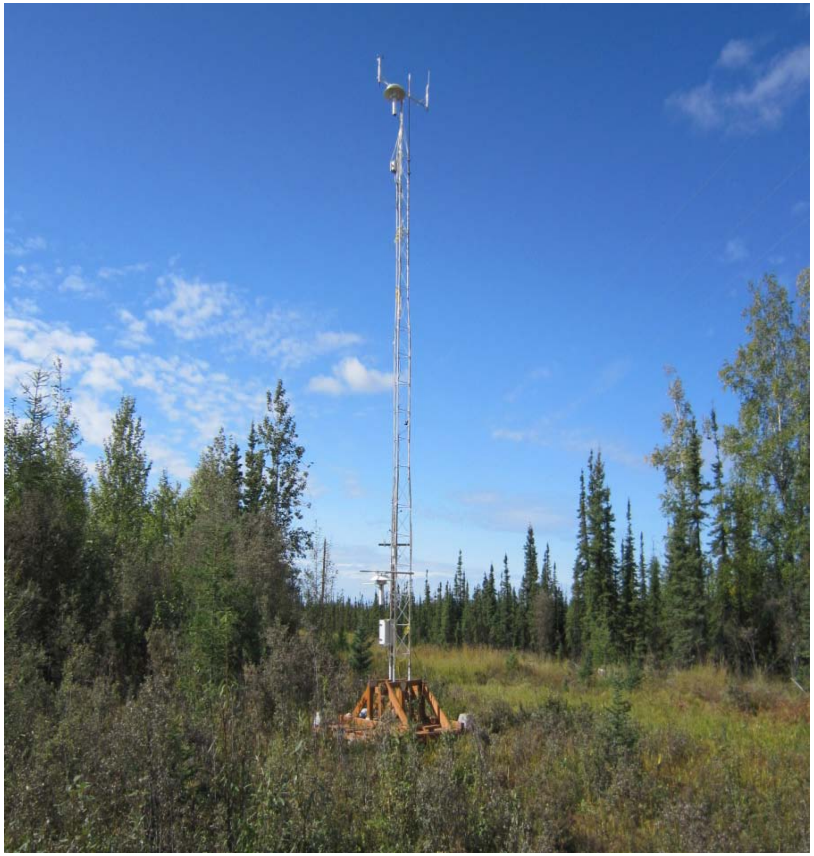
PHASE II – $PM_{2.5}$ Ambient Air Monitoring

- Eielson AFB ~3 miles east of the Fairbanks North Star Borough (FNSB) $PM_{2.5}$ nonattainment area.
- Monitored to obtain a better representation of the nonattainment area with respect to locations of potential impacts from the proposed CTL plant.
- Three measurement locations:
  - Meteorological only – near SW corner of CTL plant site.
  - $PM_{2.5}$ and meteorological measurements – two sites within the nonattainment area west of the proposed CTL site.
    - One site represents the area within the nonattainment area closest to the proposed CTL plant location.
    - Second site located at Badger Road Elementary School to provide good spatial coverage.

PHASE II – $PM_{2.5}$ Ambient Monitor Locations

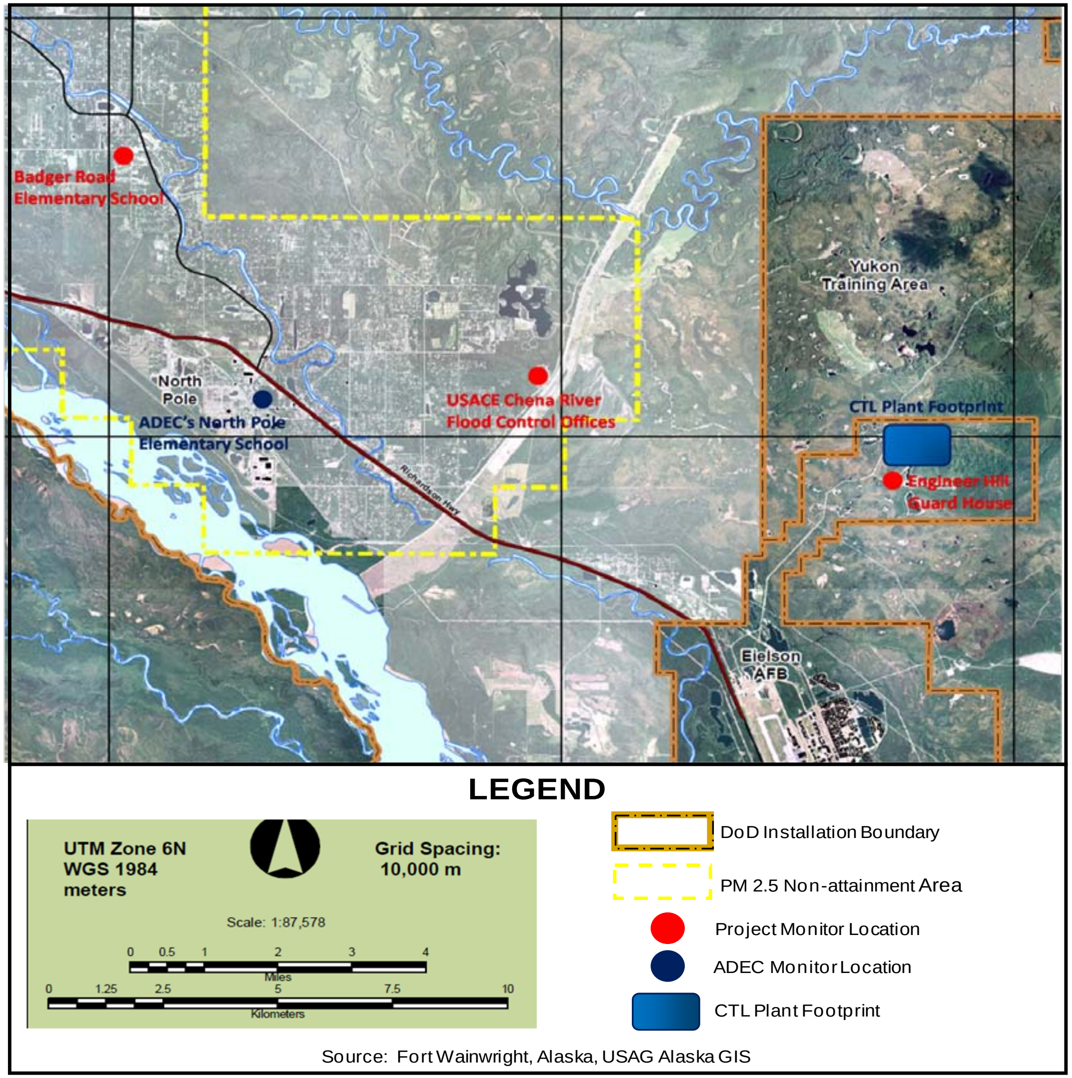
Monitoring station at Badger Road Elementary School

Meteorological tower at Engineer Hill



PHASE II – $PM_{2.5}$ Ambient Monitor Locations and Results

- Dispersion modeling conducted using AERMOD.
- Significant impact area for the modeled sources does not extend to the FNSB $PM_{2.5}$ non-attainment area.
- Sum of the model result and the maximum 24-hour concentration measured at the USACE site (as a surrogate for background concentrations) results in a total value below the NAAQS of 35 µg/m³.
- Modeling results indicate that operation of a CTL plant at Engineer Hill would not impair attainment of the $PM_{2.5}$ NAAQS in the FNSB.



For more information

- Battelle Contacts:
  - Ms. Kelley Hand – handk@battelle.org
  - Mr. Joseph Carvitti – carvittij@battelle.org
  - Mr. Michael Rectanus – rectanusm@battelle.org
  - Mr. Brian Boczek – boczekb@battelle.org
- USAF Office of Scientific Research
  - Mr. Bobby Diltz - robert.diltz@tyndall.af.mil